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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/080,468	02/22/2002	Hua Ji	M-12589 US	8384

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EXAMINER

MAI, ANH D

ART UNIT	PAPER NUMBER
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2814

DATE MAILED: 05/27/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application N .

10/080,468

Applicant(s)

JI, HUA

Examiner

Anh D. Mai

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-- Th MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 April 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-30 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-30 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 8. 6) ☐ Other:

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on April 21, 2003 has been entered.

Status of the Claims

2. Amendment filed April 21, 2003 has been entered as Paper No. 17. Claim 1 has been amended. Claims 1-30 are pending.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 1-30 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

The specification described a film deposition process including: "E/D ratios from 0.0 to about -0.05". The $E/D = (UBUC - BUC)/UBUC$

Where UBUC is deposition rate with no bias; and **BUC** is deposition rate with bias.

It is well known that, without bias, no etching component is present and with bias, there is an etching component. Therefore, the deposition rate of without bias (UBUC) is always larger than with bias (BUC).

The claimed invention, however, disclosed a negative E/D (- 0.05).

The negative E/D means $BUC > UBUC$.

How can BUC be large than UBUC while there is an etching component involve ?

The (-) appears to be a typo.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 14 and 29 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 14 and 29 recites: wherein said film is deposited over said gaps at an etch-to-deposition ratio between about 0.0 and about - 0.05.

In view of applicant argument, *minimum necessary* (claim 1) to form the dielectric layer having a refractive index of about 1.46 (claim 19). (Remarks, page 7).

Applicant further indicates that the **negative** signified different composition of the dielectric film, which means more or less silicon richness. (Remark, page 8).

The claimed "- 0.05" clearly contradicting the parent claims 1 and 19, which intended to form a dielectric film having a refractive index of about 1.46 (stoichiometry).

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Because at “- 0.05” the dielectric layer is no longer stoichiometry thus, does not have a refractive index of about 1.46 or minimum necessary to form the dielectric.

Therefore, claims 14 and 29 are not just fail to further limit the parent claims but also contradicting the scope of the parent claims, thus, indefinite.

Claim Rejections - 35 USC § 102

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

5. Claims 1-13,15-28 and 30 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Papasouliotis et al. (U.S. Patent No. 6,030,881) of record.

With respect to claim 1, Papasouliotis teaches method for filling a gap during integrated circuit fabrication as claimed including:

providing a gas mixture comprised of silicon-containing and oxygen-containing components;

selecting a flow rate of the silicon-containing component; and

performing an HDP-CVD process using the gas mixture to fill the gap with a dielectric (525) having a selected refractive index, wherein the ratio of the oxygen containing component to the silicon-containing component is substantially the minimum necessary to form the dielectric having a selected refractive index. (See Figs. 5A-C).

Note that, the ratio of the oxygen-containing component in the gas mixture of Papasouliotis is substantially a minimum necessary to form the dielectric (525).

Further, all dielectric material are known to have a selected refractive index.

With respect to claim 19, as best understood by the examiner, Papasouliotis teaches method for filling a gap during integrated circuit fabrication as claimed including:

providing a gas mixture comprised of silicon-containing and oxygen-containing components;

selecting a flow rate of the silicon-containing component;

providing a minimum flow rate of oxygen-containing component to allow formation of a film having a refractive index of about 1.46; and

filling the gap by depositing the film (525) over the gaps (510) by using the gas mixture for simultaneous high density plasma chemical vapor deposition and sputter etching (HDP-CVD). (See Figs. 5A-C).

Note that, the flow rate of oxygen-containing component of Papasouliotis is a minimum to allow the formation of a dielectric film (SiO_2).

Further, since the dielectric of Papasouliotis is SiO_2 , thus, it inherently has a refractive index of about 1.46. This matter is well known in the art. (See R. Conti et al., IDS Paper No. 3).

With respect to claims 2 and 5, the silicon-containing and oxygen-containing components of Papasouliotis comprises a concentration by volume of the gas mixture as claimed.

With respect to claims 3, 6, 20 and 22, the silicon-containing and oxygen-containing components of Papasouliotis is at a flow rate that includes claimed range.

With respect to claims 4 and 21, the silicon-containing component of Papasouliotis comprises silane.

With respect to claims 7 and 23, the oxygen-containing component of Papasouliotis comprises a O₂.

With respect to claims 8, 10, 24 and 26, the gas mixture of Papasouliotis is further includes an inert component, He.

With respect to claims 9 and 25, the inert component of Papasouliotis is at a flow rate that includes the claimed range.

With respect to claims 11, 12, 27 and 28, the ratio of oxygen-containing component to silicon-containing component of Papasouliotis includes the claimed ranges.

With respect to claim 13, the gas mixture of Papasouliotis is at pressure that includes the claimed range.

With respect to claim 15, the dielectric (525) of Papasouliotis comprises silicon oxide.

With respect to claim 16, the dielectric (525) of Papasouliotis is SiO₂ thus, inherently having a refractive index of 1.46.

With respect to claim 17, the process of Papasouliotis further comprises: providing a low frequency power source operable to form plasma from the gas mixture, the low frequency power source is providing power that includes the claimed range.

With respect to claim 18, the process of Papasouliotis further comprises: providing a high frequency power source operable to bias the substrate, the high frequency power source is providing power that includes the claimed range.

With respect to claim 30, Papasouliotis teaches method for filling gaps during integrated circuit fabrication as claimed including:

providing a gas mixture comprised of oxygen-containing and silicon-containing components, the gas mixture having a ratio of oxygen-containing component to silicon-containing component; and

filling the gaps by using the gas mixture for simultaneous high density plasma chemical vapor deposition and sputter etching (HDP-CVD). (See Figs. 5A-C).

Note that, the ratio of the oxygen containing component to silicon-containing component in the gas mixture of Papasouliotis includes the claimed ratio (1.3).

Further, note that the specification contains no disclosure of either the *critical nature of the claimed ratio of silicon-containing components to silicon-containing components or any unexpected results arising therefrom*. Where patentability is aid to based upon particular chosen dimension or upon another variable recited in a claim, the Applicant must show that the chosen dimension are critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

6. Claims 14 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Papasouliotis '881.

As best understood by the examiner, Papasouliotis teaches depositing a film over a gap having high aspect ratio including etch/dep ratio is determined by:

$$E/D = (UBUC - BUC) / UBUC.$$

Thus, Papasouliotis is shown to teach all the features of the claim with the exception of explicitly disclosing the ratio as claimed.

However, since the deposition method of Papasouliotis includes depositing an oxide film in gap having an aspect ratio that greater than the present invention, thus, the E/D ratio of Papasouliotis should at least includes the claimed ratio to fill the gap without void.

Response to Arguments

7. Applicant's arguments filed April 21, 2003 with respect to the rejection under 35 U.S.C. 112, first paragraph, have been fully considered but they are not persuasive.

As noted above the (-) appears to be a typo.

However, Applicant insists that under some conditions for low deposition rate and high aspect ratio gaps, the deposition rate with bias (BUC) may be larger than the deposition rate without bias (UBUC) because the films being deposited in the *two cases are of different*

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composition (more or less silicon-richness), and therefore the E/D ratio, as defined by applicant, may be negative.

This clearly is a conjecture. Applicant's argument is not a fact. Applicant fails to provide any support for his conclusion.

Rejection under 35 USC § 102

Applicant argues: Applicant could not find no mention in Papasouliotis of a ratio of oxygen-containing components to the silicon-containing components as claimed or the refractive index of a dielectric.

However, as discussed in the previous Office Action, to find the flow ratio, one should look into the tables. For example, in table 1, the oxygen (claimed oxygen-containing components) flow rate 10-1000 sccm and the silane flow rate (silicon-containing components) 10-250 sccm. So, the flow ratio of oxygen-containing components to the silicon-containing components, as disclosed in tables 1 is 1:1 to 4:1. Note that, these ratio also includes below 1.3.

Regarding the refractive index, the dielectric film of Papasouliotis is SiO₂ (stoichiometry) therefore, the refractive index is about 1.46.

Therefore, Papasouliotis clearly anticipates claims 1, 19 and 30.

Rejection under 35 USC § 103

In light of the new arguments, claims 14 and 29 are further rejected for indefinite.

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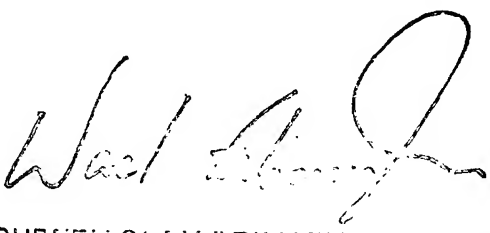
Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anh D. Mai whose telephone number is (703) 305-0575. The examiner can normally be reached on 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (703) 308-4918. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

A.M
May 19, 2003


SUPERVISOR IN CHARGE
TECHNOLOGY CENTER 2600